The involvement of students in the user-centered design process of a mobile health record: a case study.

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Figure 1: Entering objective patient data via a text input field, input suggestions and colored parameter input sliders.

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Abstract
One of the challenges when designing an electronic health record is the generational difference between general practitioners (GPs), which is especially noticeable when working with mobile devices. We discuss a paradigm shift we discovered when a mobile health record was designed using a user-centered design approach with graduated GPs and evaluated with last year general practice students [1]. Furthermore, we noticed that the usability perception is greatly influenced by the underlying medical registration system used.

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Mobile Health Record, User Interface, Usability

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H.5.2 [Information interfaces and presentation]: User interfaces.

Introduction
Usability problems are a key concern in all domains. Yet in medical applications they can cause severe health problems for the patient (e.g. prescribing wrong medication). A possible solution to minimize usability problems is to involve the user from the earliest phase onwards, which is called user-centered design. Therefore, GPs and other stakeholders should be involved in the

design process. In the medical domain, however, the involvement of the user is rather difficult due to the GPs' busy schedules and strong opinions. Students are often overlooked as they are not real end-users yet. Nevertheless, we believe that students should be involved into the design process as well. They should, as they will become the next generation of end-users that can provide useful input. Once the students graduate, designs become suboptimal quickly. Furthermore, students are not stuck in old ways and used to certain paradigms. GPs, however, are used to work according to a certain paradigm.

This position paper discusses our opinion on the involvement of students in the design process of user-centered design methodologies. First some background on whether or not to use students is provided. We then support our claim with (i) results from our earlier research in which we designed a mobile health record interface (Figure 1) [1] and (ii) two problems that we are currently investigating.

Background information

Schneiderman [8] states that all design should begin with an understanding of the intended users, including population profiles. Involved test users should represent the intended users of the system as closely as possible [3]. Developers of such systems may have a market in mind, but the actual users of a product are not known until the product is bought [2].

Von Hippel [4] proposes the lead user method, where the idea is to interview the most advanced users in the field. Lead users (e.g. older generation of GPs) face needs years before other users (e.g. students of recently graduated GPs) encounter them, and have often found solutions to their problems. The lead user method was a useful way of selecting users for the field studies of Kujala et al. [5]. For example, in one of their cases, one lead user provided as much information and ideas as five ordinary users did. However, some of the lead users' needs were too advanced to concern the ordinary users. Thus, a combination of lead and ordinary users is appropriate. Ideas gathered from lead users could be reality checked with the ordinary users and their needs. They [5] state that from a usability point of view, it is important to ensure that less advanced users are also selected.

Meyer et al. [6] evaluated health care applications with both nursing informatics students and non-student clinicians. Many participants in the student group were very concerned about patient care and focused on the implications of the product on patient care workflow. To convince companies of their results, a questionnaire was used, as companies generally insist only medical people that truly represent the target user population are used in user-centered design studies. They also found that students were not yet limited to existing paradigms.

Experiences from research

Our opinion is based on the results of our research [1] where a mobile health record for GPs, is designed with nineteen GPs through a rapid prototyping and user-centered design methodology combined with the think aloud method. During an evaluation where both quantitative as qualitative feedback was gathered from 53 last year GP students (presented in [1]), it became clear that there was a great discrepancy between the two generations of GPs. Two important problems surfaced which are now the focus of our current work. These problems could have been avoided if students were involved earlier in the design process, instead of only focusing on the intended user.

1. Evidence based information
The older generations of Belgian GPs are used to work with the SOAP (Subjective, Objective, Assessment and Planning) note registration system, which structures patient data in four categories: 1) subjective: the story told by the patient, 2) objective: the data measured and registered by the GP himself, 3) assessment: the actual diagnosis of the patient visit and 4) planning: the plan to cure the patient. But according to students' feedback, this system is obsolete, too text based and therefore not ideal for a device without a full layout physical keyboard. The current generation of GPs experienced the evolution from paper based patient records to electronic patient records. In this shift, the SOAP note system was merely ported. But for the paradigm shift between bare electronic to mobile patient files, an opportunity surfaces for a less text based system. Students nowadays learn to work with the medical history system. This system is in essence quite similar to the SOAP system, but the subjective part is replaced with guided questions, called the anamnesis. The objective is replaced by a clinical and technical examination and the assessment with the diagnosis and the planning with a policy to a cure. In order to adapt to this system, changes are needed. Mostly the subjective screen needs to change from an advanced text input screen to an evidence based question oriented screen.

This opportunity mainly arises in a mobile context. GPs do not always have the ability on a house visit to access their workstation, printer and paper literature, but can use several affordances mobile devices offer: a multi touch screen, portability, speech recognition, GPS-sensor, etc. Therefore, three alternative mobile designs were sketched and informally evaluated with four last year students and a professor of general practice as a lead user. The first alternative enabled the GP to tick off all questions that needed to be asked. The second alternative enabled the GP to take notes for each question or skip them entirely and finally, in the third alternative all question were listed for reference only and a general text input box was provided. From preliminary results, we can conclude that alternative 1 and 2 are too labor intensive and provide redundant information for experienced GPs. A GP encounters several patients a day for multiple years and knows what to ask and does not want to tick of each question over and over again. But both trained and junior GPs come across health conditions that are rare. Everybody indicated it would be an addition if they could access the evidence based information as was proposed in the third alternative (Figure 2). We need to further investigate how to combine these designs. Possible opportunities are: a search button, automatic based on what is registered into the input field or on which disease is trending in that area using the GPS-sensor, etc.

2. Visualizing examination parameters
Another working point is the visualization of the measured parameters during the examination. Currently (Figure 1) only the last value is displayed together with a colored range indicating how this value compares to 'healthy' values. The colored range is used as an effective way to communicate towards the patient. The GP can show the patient that he has to improve in order to become healthy again. The decision to only show the last value is based on the opinion of the older generation of GPs, who indicated that only the last measured value is of importance. The students, however, saw the need for a more visual representation of all the previous values. Good interactive visualizations can help provide insights (distributions, trends, and anomalies) in large amounts of data [7]. Even on a small screen that is used during a house visit, good visualizations can help the GP to spot

abnormalities more quickly and helps to provide better patient care. Indeed, a picture is worth a thousand words.

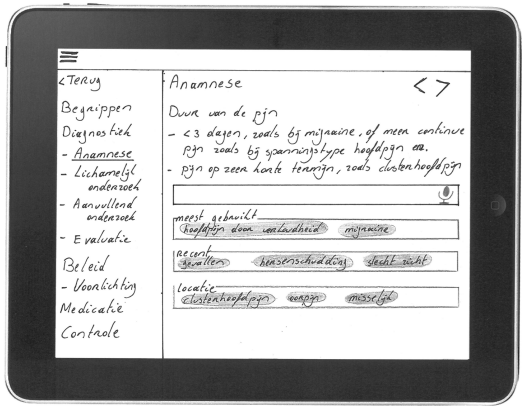

Figure 2: The third alternative. The left column guides the GP through the process. The right column shows: the evidence based questions, a text input field and the text suggestions.

Conclusion

Researching the design of a mobile health record is a timely and important problem. Generational differences are important and keeping them in mind during the design process leads to interesting insights. Especially in the health domain, regular users are hard to involve and can be very conservative; thus blocking innovation. Notwithstanding that unskilled students can influence the design in an undesirable direction, students with some practical experience are better available and less conservative. Finding the right balance between students with enough experience and regular users is a challenge. In conclusion, we consider that by incorporating students into the design process, we can augment the design of a mobile health record and in the end help GPs to become more efficient and engaged in the practice of health care.

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